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QUESTIONNAIRE III (b).

INTERNATIONAL LABOUR CONFERENCE.
THIRD SESSION.
GENEVA, APRIL, 1921.

UNIV. OF CALIFORNIA

PROHIBITION OF THE USE OF WHITE LEAD IN PAINTING.

ITEM III (b) OF THE AGENDA.

GENEVA.
INTERNATIONAL LABOUR OFFICE.
1921.

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INTRODUCTORY NOTE.

When making preparations for the preceding Sessions of the General Conference, the International Labour Office sent out extensive questionnaires to all Governments requesting them to forward all available information concerning the questions on the Agenda. Special stress was laid upon the importance of receiving the most complete information on existing and proposed legislation, and on agreements between employers and workers. Finally, Governments were asked to give their opinion on the proposed Draft Conventions and Recommendations.

This method had two drawbacks :—

(1) *Such protracted enquiries were necessitated by this form of questionnaire that the majority of the replies were received too late to allow of the elaboration of a carefully considered report.*

(2) *Some Governments appeared to consider sufficient the enquiry into existing legislation and the conditions which gave rise to it, and failed to realise the necessity of examining carefully the possibilities of international action. It was, therefore, impossible for the International Labour Office to form a proper estimate of the objections and difficulties which a draft Convention might encounter.*

These drawbacks were felt keenly during the last Session of the Conference at Genoa. Hence the following new

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method has been adopted—a method made possible by the development of the Office :—

(*a*) *The problem is studied, and existing legislation and available information on the subject are collected by one of the technical services of the International Labour Office. Requests to Governments for information or documents are confined to what is needed to complete the information already available.*

(*b*) *The Office then draws up a questionnaire relating exclusively to the possibility of elaborating Draft Conventions or Recommendations on the question at issue and to the provisions which it may or may not seem necessary or possible to include in them. The present questionnaire is of this type.*

(*c*) *When the International Labour Office has received the replies to the questionnaire and is thereby informed of the opinions of the Governments of the various States, it will proceed to draw up a General Report, together with Draft Conventions or Recommendations, to serve as definite bases for the discussions of the Conference. In order to facilitate this task the replies to this questionnaire should reach the Office not later than the* 1*st March,* 1921.

The preparation of the General Report referred to in paragraph (*c*) *would be facilitated if, where possible, several copies of the replies and important documents in English or French were communicated to the Office. For Federal States answers should be given both for the central Government and for the principal local Governments, in so far as they have legislative authority in this question.*

INTERNATIONAL LABOUR CONFERENCE.
THIRD SESSION.

GENEVA, APRIL, 1921.

ITEM III (b) OF THE AGENDA.

The question of protection against lead-poisoning has already occupied the attention of the International Labour Conference, having formed one of the subjects of consideration at the First Session at Washington in November, 1919. The Commission on Unhealthy Processes at that Conference included industrial processes in which lead is used among the occupations involving particular risks for women and children. The Conference recognised the peculiar risks of lead intoxication, and passed a unanimous recommendation concerning the protection of women and children against lead-poisoning; this recommendation invited the Members of the International Labour Organisation to prohibit the employment of women and young persons under 18 years of age in certain industries involving serious risk of plumbism.

By protecting women and children only, the Conference did not intend it to be understood that it was only these two classes of workers who were exposed to the danger of plumbism. On the contrary, the report of the Commission on Unhealthy Processes states that lead intoxication "affects men, women and children in industry." Neither did the Conference intend to limit its recommendation to any definite categories of industries involving particularly serious risk. It did not clearly and specifically define the extent of protection against lead-poisoning. This is obvious from the fact that Mr. Bidegarray, the French Workers' Delegate, put forward a motion requesting the Commission on Unhealthy Processes to give its attention to the question of the use of white lead in house-painting. As this question did not appear on the agenda, it was impossible to deal with it, but the *rapporteur* "expressed the general feeling of the Commission in pointing out the importance of the subject, and saying how action had already been taken in certain countries and the subject had been studied in others." The Commission was "of opinion that the subject should be referred to the International Labour Office to be placed on the agenda at the next Conference."

In order to give effect to this finding, the Governing Body of the International Labour Office placed the question of the prohibition of the use of white lead in the painting industry on the agenda for the Conference which is to be held in April, 1921.

* * * *

It is necessary to emphasise the fact that the most dangerous industries in which the worker is exposed to the danger of lead-poisoning are those in which use is made of lead compounds. A very small quantity of these compounds produces an effect. They easily penetrate the organism by every possible channel and gradually accumulate; on the other hand, they are eliminated extremely slowly by organs which have in the meantime suffered serious changes. (Kidney affections are particularly common.)

Whatever may have been said to the contrary, lead compounds mixed with oil by hand further increase the possibility of poisoning through the skin.

The danger of lead-poisoning in industry is of course not limited to white lead or to painting operations. On the other hand, it is only against the effects of white lead that a successful campaign can be undertaken. Investigations, together with technical and scientific research, have sufficiently demonstrated the possibility of replacing white lead by substitutes.

The agenda of the next Conference limits consideration of the question to the "prohibition of the use of white lead in painting." It would, however, be useful to consider the question of lead intoxication in all industries involving the use of lead and lead products.

The question of the risks run by painters using white lead has occupied attention for many years, and has been the subject of much discussion between the advocates and opponents of a substitute for carbonate of lead. This discussion will not have been in vain if it succeeds in calling the attention of public authorities to the unfortunate position of workers in white lead, particularly house painters, and if it gives rise to effective protective measures.

A glance at the enormous number of documents and works of a technical, medical, chemical and legislative nature existing on the subject enables an estimate of its complexity to be formed. The abundant evidence, on which it is now possible to base an impartial judgment, makes it permissible to say that the question is sufficiently ripe from the technical point of view to form the subject of an international Convention.

THE RISK OF LEAD POISONING.

A.—The Medical and Social Aspect.

Plumbism is an occupational disease common to a countries, and takes the foremost place in the patholog of labour.

The risk accompanying the use of lead in genera and of white lead in particular, is increased by reaso of the slow and insidious way in which the poison infect the organism so that the worker feels no preliminar symptoms.

It should be remembered that painters, like othe workers in many industries, use materials of which the do not understand the composition, and which are sol under numerous trade names. Thus, white lead i variously known as Venice white, Cologne white, Krem white, Dutch white, Tyrol white, Magdeburg white, lithographic white, silver white, slate white, pearl white, etc

From the scientific point of view, it is difficult t admit the contention of some investigators (who wer not themselves medical men) that “ workers wh continually make use of white lead are not necessaril infected.” It is a fact that the power of resistanc varies with the individual : one worker shows symptom of poisoning after a few days, another after a few weeks or a few months ; another, on the contrary, only afte years. In this connection, it is no longer possible t deny the influence which hygienic habits exercise i retarding the approach of plumbism. There is n doubt that the more unhealthy the process owing to th escape of dust, the more soluble the product, and th larger the amount of dust absorbed or paste manipulated, the more rapid the intoxication. Professo Carlson has made a study of the solubility of lead ulphate and carbonate of lead in the gastric juice. Experiments proved that the solubility of the sulphate was 9·5 per cent., as against 46·1 per cent. for white ead, and that for the pure salts the solubility was 26·6 per cent. and 64 per cent., respectively.

Neither race, age nor sober habits afford immunity rom lead-poisoning, which is brought about through he open tracts of the body of which the digestive canal s undoubtedly the most important. The skin also ffords a means of entry for the poison, by direct contact. The respiratory canals have only a secondary importance n this connection, and even this is still contested.

In the course of heated controversies, use has been nade of statistics which, it cannot be denied, do not ead to identical conclusions on this difficult question. As a matter of fact, the original statistics, in consequence f having been quoted time after time more or less naccurately, have ended by becoming distorted and alsified and by doing harm to a cause which might ave been taken as proved.

On the other hand, it must be confessed that certain nvestigators who were not doctors, have not always een the problem in its true light, and their conclusions ave therefore not always been arrived at with the ecessary scientific exactitude.

They should have appreciated the necessity of securing thorough examination of the workers instead of simply tating that "from the point of view of health, their ppearance seemed satisfactory," or contenting themelves with sending *questionnaires* to medical men. On he other hand, the enquiries conducted by experts n all countries have definitely established the fact that lumbism is a typical occupational disease, and that working painters, especially, have a high sickness rate and are least capable of resisting infectious disease a fact which is corroborated by the statistics relating for example, to death from typhoid fever.

The lack of precision in the diagnosis of the various forms of illness under which lead-poisoning is disguised explains the uncertainty of the statistics which are currently quoted in connection with risk from plumbism

The figures furnished by German sick benefit societies are the only ones which exactly reveal the sickness rate among painters, especially when compared with those furnished by the sick benefit societies of single trades. In the first place, there is a considerable increase in the number of diseases of the kidneys, nerves, digestive organs, etc., a number largely in excess of the cases specifically classified under the heading of "lead poisoning." In addition to this, the duration of these maladies and the frequency with which they occur in the case of painters, is much above the average.

This is shown by the following figures* of the German Sickness Insurance Funds, comparing the experience of the whole of the Funds (over 20,000) in 1910–1912, with those for painters in Breslau and Leipzig :—

1910-1912.	Number of cases of sickness per 100 workmen.	Average number of days of sickness per spell of sickness.	Average number of days of sickness per 100 workmen.
All Funds... ...	42·5	20·0	850
Breslau (Painters)	52·5	23·5	1,230
Leipzig (Do.)	43·0	24·0	1,017

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* From Klein : *Die Deutsche Arbeiterversicherung*, Berlin, 1911, and *Versicherungsboten*, Oldenburg, 1912 and 1914, quoted in *Zentral Blatt für Gewerbhygiene*, April, 1915, page 67.

Hence whereas the average sickness experience shows 50 days *per* 100 workers *per annum*, the experience for ainters rises to 1,230 in Breslau and 1,017 in Leipzig.

The Berlin painters' sick benefit society, with n average of 4,637 members for the years 1900–909, had a yearly average of 13·82 days' sick-ess per member, of which 2·86 per cent. were ue to lead-poisoning. It should be added that in x years the expenditure in sickness benefit for illness her than plumbism was 219,192 *marks*, as against 139,093 *marks* for cases of plumbism.

The statistics prepared by the Leipzig sick benefit ocieties (1910) show 351 cases of lead poisoning amongst 00,000 compulsory members (770 among voluntary embers). In the schedule of illnesses due to lead-oisoning classed according to occupations, painters ow 60·4 per cent., as compared with 34·8 per cent. r pottery workers and 43·4 per cent. for printers; 3½ per cent. of the diseases, which are divided into ty classes, affect painters; then follow workers in hite lead factories and lead colours with 20 per cent., ad and zinc foundries, etc. Out of 100 cases of ad poisoning which were observed in Prussian ospitals during the period 1904–1908, painters showed e highest proportion, followed at some distance by ad founders and workers in white lead; the average eing 34·6 for painters, as against 22·9 for white lead orkers and 13 for founders.

In England, house painters are not included in the st of occupations in which notification of occupational sease is compulsory. However, as lead poisoning is ccupational in their case, the inspectors have been ble to report numbers of instances. In the ten years

(1900–1909) the total number of cases of lead-poisoni
among painters was 1,973, of which 383 were fat
On the other hand, the total number of cases
lead poisoning in other industries coming under t
law was as high as 6,762, of which 275 were fat
The proportion of fatal cases is therefore 4·06 p
cent., as against 19·41 per cent. for painters.

The use of lead sulphate instead of white lead h
greatly increased in America where the poisono
properties of the two substances have been much d
cussed. The Pullman Company, which has alwa
had a large number of workers suffering from le
poisoning, and which took no special precautions
protect them, suddenly substituted lead sulphate in t
place of white lead in 1912 at the same time that
law regarding the establishment of a health service a
the installation of washing and eating accommodati
in unhealthy industries came into force in the Sta
of Illinois. In 1911 there was a monthly avera
amongst the staff of the Pullman Company of 18 cas
of lead-poisoning to 490 workers, but after the replac-
ment of white lead the number fell to 6 per month
650 workers, and the average continued to decrease.

In addition to serious investigations and scienti
research possessing all the necessary guarantees, the
are a number of assertions which were possibly tr
thirty years ago, and of which polemical use has be
made in argument. They have been thereby transform
into absolute formulæ which have been and are st
repeated everywhere. There is no doubt that gra
objection might be made to the method of conducti
certain enquiries which very often led to no conclusio
because of their incompleteness.

Experience has shown that when the attention of ivate or hospital doctors is drawn to the question of ad-poisoning, the statistical results of the investigations e very different, and that there is no trouble taken in agnosing the cases. These superficial opinions have en disastrous to sound preventive treatment. It must admitted that the workers almost invariably tell edical men and investigators that they have had the od fortune to escape the poison. When pressed, they sist that they have never suffered from colic or lead ralysis, etc. On the other hand, methodical examina- on reveals the ineradicable signs of lead impregnation. he workers and numbers of medical men still believe at the clinical symptoms of lead-poisoning are con- ned to colic and paralysis. It is necessary, therefore, insist on the main point of the question, which is at lead-poisoning is not always accompanied by thognomonic symptoms, and it is this difficulty in agnosis, especially on a superficial examination, which ay have led certain medical men to deny the existence lead-poisoning.

The doctor should always ask the occupation of the orker, and if he does this, the first symptoms of lead-oisoning rarely escape him on an examination. Further, is necessary to ascertain how many sick persons, eated for various maladies, are in reality cases of ad-poisoning, and how many cases of lead-poisoning ve inadvertently escaped medical diagnosis. As a atter of fact, the sick worker does not consult the ctor until the acute symptoms of advanced poisoning anifest themselves, since in the majority of cases only causes, during long years, a more or less marked ndition of anæmia, after which the evil, latent until that point, suddenly shows itself owing to some outsi circumstance. These workers, who very often do n show even "the blue line," are infected by lead poiso and examination of their blood often allows of t diagnosis of plumbism, even during the latent period.

Finally, alcoholism plays a prominent part in t pathogeny of lead-poisoning. Certain writers ha advanced the theory that abstinent workers are mo affected than the others, but there is no reliab evidence to support this assertion.

Labour legislation neither can, nor should, be inspir by a principle which would divide the workers in "skilled workers" and "manual workers" or "casu workers," with the object of arriving at the conclusi that it is not necessary to make a law to protect t second category. The fact should not be lost sight that in many cases it is a question of taking speci protective measures for certain categories of person and against certain compounds which are particular injurious. If, owing to the use of substitutes, the u of the harmful compound can be prohibited, then pr hibitive regulations are highly desirable. Such is t case as regards the employment of white lead in paintin

In conclusion, it may be said :—

(1) Science, in investigating the relation betwe diseases and occupations, has ascertained an proved that lead poisoning is in the front rank social diseases and constitutes a veritable soci scourge, which ought to be fought with t greatest energy.

(2) The campaign should be carried out scientificall and methodically, since lead-poisoning appears t respect persons whose excretory organs functio

normally and who observe a strict personal hygiene.

(3) From the point of view of strict prevention, every person exposed to the risk of lead-poisoning should be considered as a possible case of lead-poisoning.

B.—THE PREVENTION OF LEAD-POISONING.

The campaign against lead-poisoning was opened by propaganda having for its object the education of the persons concerned (employers and workers), and people have chosen to believe, as was only too easy, that the number of cases of lead-poisoning decreased owing to the distribution of leaflets, the compulsory installation of washing accommodation, etc. It cannot be denied that education plays an important part in the campaign against occupational diseases. In particular, the usefulness of preventive measures cannot be contested when industries are in question in which the measures to be taken against lead-poisoning may be confined to energetic intervention in the processes of production and to permanent action by inspectors with a view to ensuring strict adherence to the regulations.

Statistics prove unmistakably that a decrease in lead-poisoning among printers, workers in red-lead factories and even among white-lead workers, has been noticed in permanent workshops where preventive measures have been taken. Employers and managers of certain well-organised factories have voluntarily taken excellent hygienic measures. They have allowed the workers the time and means to keep themselves clean; they have distributed rations of milk, with the two-fold object of fighting alcoholism and of increasing the resistance of the organism to poisoning. These measures, however, have only been taken in factories; they are not applicable in the case of yards or small industries wher the working employer has neither the interest nor th means to carry out even the most modest measures o individual hygiene, and where it is easy to evade restrictive measures which are, furthermore, quite ineffective in practice.

Any control of hygienic measures is impossible in the case of painters and workers in similar occupations where places of work are scattered.

Preventive measures to be at all efficacious as regards lead-poisoning in the painting industry could hardly consist of other than the following :—

(1) Compulsory notification of occupational lead poisoning, since the appreciation of the dange is the indispensable basis of precautionary measures ;

(2) Prohibition of the sale of white lead other than in the form of a paste.

(3) Placing on the market colours ready for use since the preparation of colours by painters themselves is a grave source of risk of plumbism.

These measures are, nevertheless, notoriously insufficient. The risk of infection by lead-poisoning among painters and workers in similar trades assumes exceedingly dangerous proportions. The preventive measures referred to can only be accepted in the absence of something better, for the painter's occupation calls for the maximum amount of protection possible.

After long experience in the Vienna Sick Benefi Societies, Dr. Teleky, advising medical officer for occupational diseases, came to the conclusion (1913) that the marked diminution in lead-poisoning amongst working painters was due, not to the application of preventive regulations, but simply to the prohibition of the use of lead colours for indoor work.

The only really efficacious measure of which the application could be controlled would be the absolute prohibition of the use of colours with a white lead basis.

Such a radical measure could not, however, be introduced if colours with a white lead basis could not be replaced by innocuous substances equally good from the technical point of view. All experts agree at the present time on this point, that the substitution of white lead by harmless substances is possible. This is being carried out to a large extent, even for outdoor work.

C.—The Technical Aspect.

The proposal to replace white lead by zinc whites and other innocuous substitutes nevertheless still meets with lively opposition.

The fundamental problem is to determine whether the use of white lead in house-painting should or should not be prohibited by law. The results of enquiries may be classified as follows :—

(*a*) Those which only demand special regulations ;
(*b*) Those which recommend prohibition for indoor work ;
(*c*) Those which imply prohibition for both outdoor and indoor work.

It should not be forgotten that the campaign in avour of the prohibition of the use of white lead originated in France. The quantity of reports and documents of a technical, medical, commercial and legislative nature, published in France is enormou and the controversy between those in favour of libert and prohibition respectively has become classical.

As early as 1808, Fourcroy, Bertholet and Vauquelin, the academicians, were called upon to advise on th respective values of white lead and zinc white, an concluded their report by stating that "the disadvantages of using zinc white are so small as compared wit the disadvantages of using white lead that no on can reasonably refuse to adopt it, at any rate for house painting. The colours which it produces are cleare and more distinct; it does not lose its brilliance quantity for quantity, it covers a larger surface, etc."

Experiments seemed to prove that zinc white paint covered less than white lead paints, and that "sno white" covered less than zinc white paints. Howeve weight for weight, zinc white covers a larger surface tha white lead.

Good painting should fulfil the following requirement which are quoted in order of importance :—

1.—*Covering Power*.—This is the quality which generally attributed to white lead and found lackin in zinc white. In reality, this quality of coverin power and that of resistance to atmospheric agenci were not admitted in zinc white up to 1907–191 and it was maintained that though zinc oxide migl replace white lead in a large number of cases (in practic the use of zinc oxide was already common), yet whi lead could not be completely replaced by zi oxide.

In working with a pure substance, mixing with gave a liquid paint in consequence of the molecul composition of zinc oxide; so that, in order to cover surface with the least possible amount of solid matter, it was necessary to dilute it less or to give three coats of zinc white for two of white lead.

As a result of improvements in manufacture of oxides of zinc in particular, the solution of the problem is easier to-day than formerly, and it may be said that the strongest objection which was made to the use of zinc whites has been overcome.

The placing on the market of plumbous zinc whites onstitutes further progress from the technical point of view, and at the present time the results obtained with them are quite as satisfactory as those obtained with white lead paint.

Successive experiments carried out in Belgium, in Denmark, and in America have shown that zinc white ontaining from 2 to 4 per cent. of basic sulphate of ead has greater covering power than white lead.

It is now established that slightly plumbous zinc white "kills" from two to four times more black or lue than white lead, and that this is due to its special method of manufacture and to the amorphous condition f its molecules, rather than to its actual lead content. This very complex question, which is also at the same time a problem of physics and molecular chemistry, will e examined later.

2. *Solidity.* — The comparative experiments made ith pure zinc whites lead to the conclusion that for nteriors they are much superior to white lead and as ood for exterior use; for wood, they are equally ood either for interior or exterior use (Milan 1907–908).

White lead is not better than zinc whites from the oint of view of resistance to atmospheric changes and especially to sulphuretted vapours and certai oxidising agents.

The same excellent results have been obtained by th North-East Painting and Oil Trade Association (England), in the painting of buildings, vehicles and th interiors of railway stations, in the work executed b the Admiralty since 1907, and especially by the Offic of Works (England).

The fact should never be lost sight of that in order t ensure good outside paint work, it is important not t use the same oxide of zinc or the same elements as ar used for lead paint.

The technical expert now knows the proportions an formulæ for the different kinds of paint-work (building wood, metal, etc.), mastics, covering coats, etc.

3. *Grinding in Oil.*—The good results obtained wit white lead paints used to be attributed to the presen in them of lead oxide reacting on the free acids in th linseed oil. A homogeneous compound was thus obtained, stable and resistent, which is certainly a lead oleate with a polish which is hard, impermeable and ver resistent to atmospheric influence.

Zinc whites on the contrary, would only be a mixtu of a passive solid (zinc oxide) with a liquid (oil). A the experts now agree in saying that *oxides of zi re-act just as well on the free acids in linseed oil*, and th difference in the quality, as pigments, of zinc colou and lead colours is rather due to physical differenc than to the results of chemical reactions.

Plumbous oxide of zinc combines very easily wi oil. This product, rarely pure white in the powder state, nevertheless lends increased whiteness wh ground. Technical experts state that the greater t miscibility of a colour with oil, the greater its solidity and power of resistance. From this fact results the special suitability of this form for painting ships.

This is the conclusion arrived at by the principal experts of the London Paint and Varnish Society, by the United States Paint Manufacturers' Association, by the Washington Institute of Industrial Research (1912), by the English Special Commission (1918), and by the Dutch Commission. This last, charged in 1909 with making an enquiry into questions relative to the prohibition of the use of white lead, reported, after five years spent in study and comparative experiments with white lead, lithopones, pure zinc and plumbous zinc, that the last was superior to all the other substances from the point of view of durability, covering power and cheapness, although chemical analysis was not favourable thereto.

4. *Fumes.*—The question as to whether freshly applied white lead paints emit lead fumes capable of causing absorption of lead by the respiratory organs has not been answered in the affirmative, as stated by BERTHELOT.

The researches of BALY and other English experts have discredited the presence of lead, but have demonstrated, on the other hand, that of an oxidised product of linseed oil (non-saturated aldehydes).

It is not the same with zinc-white paints. This substance was supposed to be responsible for cases of arsenical poisoning occurring amongst workers occupying offices freshly painted with zinc white; but this accusation was withdrawn, as it was proved to be a question of collective arsenophobia (Sweden).

5. *Drying Qualities.*—White lead possesses a very high drying-power, greater than that of zinc whites.

It suffices, however, to add to the latter a very small quantity (1 to 3 per cent.) of a drying compound in order to obtain a paint as good as that obtained with white lead (this was the experience of the Annexe to the Pasteur Institute). Plumbous zinc whites have superior drying powers and give a coat of paint which is less liable to " crackle " than does white lead.

6. *Method of Use.*—A criticism commonly directed against zinc white is based on the practical difficulty of using it. The simple truth is that every working painter has his own methods and does not care to change them and to have to accustom himself to the new trick of mixing, even though it is easily acquired.

7. *Tints.*—Even the opponents of zinc whites have always admitted that they yield tints of an unfading whiteness and freshness, which makes them much superior for interior decoration to white lead, which is liable to turn yellow, especially when it is not exposed to the light. This is illustrated by the results obtained by a Dutch contractor who painted the interior of his house with zinc white and reported that after nine years the paint was still in good condition (English Report, 1918). Zinc white paint becomes very hard, is easily polished, does not become sulphuretted by vapour and resists the influence of lighting gas.

8. *Cheapness.*—Experiments have shown that zinc white is superior for indoor work as regards tint and covering power (France, Switzerland, Italy and Holland) and that it is preferable also for outdoor work on wood and iron (Milan). Before the war, plumbous zinc white rendered possible a saving of 15 per cent. as compared with white lead. During an enquiry made in England in 1918 the saving effected was, according to

witnesses, as high as 10 per cent. In any case, it is very probable that an increased demand would lead to a decrease in price.

Plumbous Zinc White.

Oxides of zinc are obtained industrially by various processes, but chiefly by the direct process (treatment of the ores), or the indirect method (treatment of the metal). The preparation of zinc white by the direct method does not eliminate impurities or yield a chemically pure substance, as can be done by other methods, particularly the indirect. However, this advantage is of no value from the technical point of view. On the contrary, the white obtained by the direct method is much superior as regards freshness of tint, the ease with which it can be applied with the brush, its covering power, the facility with which it combines with linseed oil and its excellent adhering qualities.

Whilst in the past an impurity of 1 per cent. was accepted, to-day chemical knowledge permits an allowance of 4 per cent., while further improving the pigment and effecting an economy of about 15 per cent.

It is important to emphasise the fact that the maximum of 4 per cent. cannot be exceeded for technical reasons. If lead is combined with zinc white in larger proportions, the darkening which is noticeable increases in proportion to the percentage of lead; there is also an increase in opaqueness due to the action of essence of turpentine.

Plumbous zinc white is an oxide of zinc containing a small proportion of basic lead sulphate *which is not* *precipitated or mechanically mixed* with the zinc white, but is obtained by sublimation of the ore in the furnace itself simultaneously with zinc oxide, so that every molecule of zinc oxide is, so to speak, impregnated with a small quantity of lead salts.

It should be stated without hesitation that there can be no question of suppressing the use of white lead in order to adopt in its place a substance containing lead which " would not be as innocuous as people wished to imply."

However, given the condition in which the small quantity of basic sulphate of lead is found, this element could not have harmful effects. This is proved by the periodical enquiries of the Labour Medical Inspection Service of the Dutch Government, whose strictness in this matter must be admitted, although the sanitary conditions in the factories are not remarkably good.

Experiments made since 1907 in the painting shops of the Belgian State Railways, as regards both indoor and outdoor work, in order to obtain a substance which would resist bad weather as well as smoke, led to the same conclusion.

It is true that many painters add white lead to zinc white in a proportion of 2 to 5 per cent. It is important, however, to remember that a mechanical mixture of 2 to 4 per cent. of carbonate of lead with pure zinc whites does not yield the same result as a mixture with plumbous zinc white. In order to have this molecular condition, it is essential that the zinc oxide should be produced in an atmosphere in which lead is present and where every particle of oxide of zinc is closely combined in infinitesimal proportions with lead salts. From this results a marked modification in the microcrystalline condition which is more easily brought about during oxidisation in the presence of lead salts than in their absence.

Practical Experience.—The importance of the results to be obtained by the use of zinc white and especially the plumbous variety, even in outdoor work, has already been demonstrated.

In consequence of general experiments made with specially pure zinc whites (99·07 parts pure), and in view of the favourable results obtained with substitutes for white lead and also of the great importance of the question from the point of view of health, enquiries undertaken in France, Belgium,. Italy, England, etc., resulted in the prohibition of the use of white lead in the painting of interiors. It was ascertained in 1910 that the use of white lead was prevalent in Northern Italy, while south of Florence, for technical and economic reasons, zinc white has been successfully used for many years to paint buildings, bridges and vehicles.

The same enquiry also revealed the fact that many contractors (20 out of 50 who were interrogated) made successful use of zinc white "in order not to end like father." The others declared that they preferred to work in the old style, while admitting that the lack of success in work done with zinc white for government departments was easily explained by the fact that the official contract price per square metre was too low and consequently the work could not be properly done.

The enquiries carried out by the Statistical Office attached to the Austrian Ministry of Labour and the Chamber of Commerce of Southern Austria, and the opinions of numerous experts, have been favourable to the prohibition of the use of white lead for indoor work.

As regards outside work, investigations and expert opinions (except those of Vienna), have also led to the conclusion that a substitute can be found for white lead. It has been said, and rightly, that even if the technical advantages derived from the use of substitutes were not such as practice and experience has proved them to be, their resistance to bad weather could easily be increased by adding another coat of varnish. As Dr. TELEKY said, "one coat of varnish is better than many cases of lead-poisoning."

Experiments carried out during three years by the American Paint Manufacturers' Association (U.S.A.) in Atlantic City and North Dakota, confirm the inferiority of results obtained from zinc white in comparison with those obtained from plumbous zinc whites. The Italian State Railways have used these special plumbous zinc whites for about 10 years.

It is to be noted that the contracts of Government Departments in France*, Belgium, Switzerland, Sweden and Holland, etc., while prescribing the exclusive use of zinc oxide as the result of pressure from the painters' associations which had demanded the prohibition of white lead, have all raised the percentage of lead salts from 1 per cent. to 4 per cent.

Finally, although the use of white lead has not been regulated in Sweden, and although there are neither white lead nor zinc white factories there, the painters have long preferred zinc white. In fact, the consumption of zinc white has increased in six years from 3,022 tons to 4,244 tons, whilst that of white lead has decreased from 511 tons to 501 tons.

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* In 1911 the Ministry of War raised the percentage of lead from 2 per cent. to 3 per cent.

OTHER SUBSTITUTES FOR WHITE LEAD.

(*a*) Amongst substitutes for white lead, mention hould be made, after zinc whites, of "lithopones," vhich for nearly fifty years, thanks to the technical rogress made in France, Germany and England, have een well to the fore among colours in general use for ndoor work. These are composed, as is well-known, f sulphide of zinc and barium sulphate, precipitated n the proportion of 29 to 30 per cent. of the former to 0 to 71 per cent. of the latter, in which mixture there s no trace of natural barytes or any impurity of any ind. These substitutes are innocuous and answer all equirements from the technical point of view (freshess, whiteness of tint, covering power superior to that f white lead and solidity, when the compounds are erfect and of guaranteed origin). In view of the are required in their manipulation if good results are lesired, they are not particularly suitable for outdoor vork.

(*b*) For some years past there has been going on in ngland an increasing manufacture of wonderful "water-aints," intended specially for indoor work; the best esults can, however, only be arrived at by the use, as basis, of an irreproachable lithopone specially preared for the purpose.

(*c*) The trade has also put on the market compounds vith a basis of zinc sulphides which require special reparation, and other compounds with which we are ot concerned for the moment and which naturally ave their advocates and opponents.

CONCLUSIONS.

It is agreed that every possible means must be ma
use of to instil in the minds of all persons concerne
the firm conviction that they can themselves do mu
for the preservation of their health. But though
is possible to diminish the danger of lead-poisoning
a considerable degree by the action of the intereste
persons, and that of the representatives of the nation
government, no regulation of the use of white lead ca
be effective without the willing assistance of all. U
fortunately, the application of an efficient preventi
of lead-poisoning is especially difficult in the ver
industry where it is most needed—that is, in hous
painting. The best regulations are only valuable
so far as they are applied. These simple measures
precaution cannot be applied in scattered workshops wit
sufficient rigour to assure the efficacy of a law.

The highly detailed system of regulations propose
by a minority of the opponents of the absolute prohib
tion of the use of white lead in painting must be co
sidered from a strictly practical point of view. F
example, they demand, in the case of certain speciall
dangerous work, such as rubbing down and scrapin
a reduction in the hours of labour, the exclusion
apprentices, the use of respiratory masks, and so o
It seems, however, hardly possible to put these propositions into actual practice.

The choice lies between entire prohibition and
prohibition. If the use of white lead in painting
dangerous, it is impossible to limit the prohibition
first to a part of the process, and to extend it to th
other part only after an interval of two or three year

Neither is it practicable to distinguish between indoor and outdoor work. The distinction is specious; there are forms of work which are intermediate, and it is impossible to lay down an exact delimitation between them. Moreover, if white lead be dangerous for the indoor painter, it is dangerous also for his fellow out of doors.

Though the minority of the Commissions of Enquiry hold that the evidence collected does not indicate the absolute necessity of substituting zinc white for white lead in *outdoor* work, the majority in the various countries consider that the demand for the prohibition of the use of white lead in house-painting is sufficiently justified by the argument arising from considerations of the health of the workers and that there is no necessity to cite the favourable evidence of experience, the technical results obtained by house-painters, civil and maritime engineers and the State workshops (in Belgium, Italy, etc.) and the approbation of a large number of both employers and workers. The manufacture and application of white lead substitutes have, moreover, made such progress that the prohibition of the use of white lead can now be envisaged without any fear of its results. The numerous and minute researches which have been made in many countries for many years past have placed it beyond doubt that oxide of zinc, properly treated, can be used as the basis of a product giving every advantage given by white lead, whether in covering power, drying qualities or durability. It is, moreover, certain that an increase in the demand for it will result in an improvement in the zinc white now marketed, and will cause search to be made for even more effective products.

Care and intelligent attention will ensure that result as good as those obtained from the best white lead ar obtained from this compound.

It is necessary to add that it is only the legal restriction of the use of white lead which is proposed. It would still be used in work other than that of painting under certain conditions which must be laid down.

The prohibition of the use of white lead in painting ought also to be accompanied by provisions of a transitory nature, taken in consideration of the interests of manufacturers.

In France, on the occasion of the prohibition of the use of white lead, the question was raised of the indemnity to be given to the owners of white lead works. But the Senate which had at first introduced into the law a clause granting indemnities, finally rejected this proposal. In this connection it should be pointed out that there is here no question of expropriation, and there cannot therefore be any question of an indemnity It may now be said that legislation everywhere has proceeded on the principle that measures limiting industrial freedom with a view to the protection of the life or the health of workers do not give occasion for indemnities. The prohibition of the use of phosphorus is a case in point. The protection of human health rises above all other considerations. In any case, to accord an indemnity would be to set up a very dangerous precedent.

QUESTIONNAIRE.

1. In view of the fact that it is now technically possible to replace white lead in painting by efficient substitutes, are you of opinion that a Draft Convention, prohibiting the use of white lead in painting, should be submitted to the Conference ?

2. If so, do you consider that a period should be allowed before the prohibition would come into force ? Please indicate what period you think necessary, and why ?

3. What measures of supervision and control in the application of this prohibition do you suggest ?

4. If your Government does not approve of a Draft Convention prohibiting the use of white lead in painting, what measures do you propose in order to meet the dangers arising from its manufacture and use ?

N.B.—In order to facilitate the task of preparation for the Conferenc of 1921, *please state :—*

What legislative or other measures intended to diminish or remove th danger of lead-poisoning in house-painting are at present in force in you country ?

Please supply, in addition, all the available statistical informatior annual, if possible, since 1910, *upon the following points :—*

A. (1) *The number of house-painters ;*
    (2) *The number of cases of plumbism amongst house-painters classified, if possible, according to the form of illness : colic paralysis, nephritis.*

B. (1) *The number of persons employed in lead and zinc industria undertakings ;*
    (2) *The output of lead and of zinc.*

These figures should be shown in tabular form, as follows :—

Industries.	Number of establishments.	Number of workers employed.				Quantity produced (in tons).	Quantity imported (in tons).	Quantity exported (in tons).
		Children.		Women.	Men.			
		Under 15 years.	Between 15 & 18 years.					
LEAD.								
a) Treatment of lead ores								
b) Treatment of lead in metal form								
c) Manufacture of white lead ...								
d) Manufacture of varnish, etc., on a lead basis								
ZINC.								
a) Treatment of zinc ores								
b) Treatment of zinc in metal form								
c) Manufacture of zinc white ...								
d) Manufacture of varnish, etc., on a zinc basis								
e) Manufacture of lithopones ...								
f) Manufacture of sulphate of zinc								
g) Manufacture of other substitutes for white lead								

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